

WHAT IS CLAIMED IS:

1. An objective lens drive apparatus for use in an optical pickup, comprising:

5 a magnetic circuit including a magnet magnetized in at least three polarities; and

a coil unit including a focus coil, a tracking coil and a tilt coil,

wherein the focus coil, the tracking coil and the tilt

10 coil are disposed within a magnetic gap of the magnetic circuit.

2. An objective lens drive apparatus according to claim 1, wherein the magnet is magnetized in four polarities.

15 3. An objective lens drive apparatus according to claim 1, wherein the magnet is magnetized in three polarities.

4. An objective lens drive apparatus according to claim 1,

20 wherein the number of the focus coils is two, the number of the tracking coils is two, and the number of the tilt coils is two,

25 wherein the magnet includes two magnet sections respectively disposed in two upper and lower stages in a focus direction and each magnet section magnetized in two polarities

in a tracking direction, whereby said the has four poles magnetized.

5. An objective lens drive apparatus according to claim

5 1,

wherein the number of the focus coils is four, the number of the tracking coils is two, and the number of the tilt coils is four,

10 wherein one pole of said magnet has an I-shaped front surface, and two other poles each having a quadrilateral-shaped front surface are inserted into the other space of the one pole, whereby said magnet has a quadrilateral-shaped front surface as a whole and has three poles magnetized.

15 6. An objective lens drive apparatus according to claim

1,

wherein the number of said focus coils is two, the number of said tracking coils is four, and the number of said tilt coils is four,

20 wherein one pole of said magnet has an H-shaped front surface, and two other poles each having a quadrilateral-shaped front surface are inserted into the other space of said one pole, whereby said magnet has a quadrilateral-shaped front surface as a whole and has three poles magnetized.

7. An objective lens drive apparatus according to claim 1,

wherein the number of said focus coils is two, the number of said tracking coils is two, and the number of said tilt coils is four,

wherein one pole of said magnet has a T-shaped front surface, and two other poles each having a quadrilateral-shaped front surface are inserted into the other space of said one pole, whereby said magnet has a quadrilateral-shaped front surface as a whole and has three poles magnetized.

8. An objective lens drive apparatus according to claim 1, wherein the magnetic circuit includes a plurality of the magnet, and the coil unit is disposed within the magnetic gap formed by the magnets.

9. An objective lens drive apparatus according to claim 1, wherein the coil unit includes a plurality of printed circuit boards, and the focus coil, the tracking coil and the tilt coil are separately mounted on the printed circuit boards.

10. An objective lens drive apparatus according to claim 1, wherein the coil unit includes a plurality of first printed circuit boards and second printed boards, and the focus coil and the tracking coil are mounted on the first printed circuit

board and the tilt coil is mounted on the second printed board.

11. An objective lens drive apparatus according to claim 1, wherein the coil unit includes a plurality of first printed 5 circuit boards and second printed boards, and the focus coil and the tilt coil are mounted on the first printed circuit board and the tracking coil is mounted on the second printed board.

10 12. An objective lens drive apparatus for use in an optical pickup, comprising:

two magnetic circuits each including a magnet magnetized in at least three polarities; and

15 a coil unit including a focus coil, a tracking coil and a tilt coil,

wherein the focus coil, the tracking coil and the tilt coil are disposed within a magnetic gap of the magnetic circuit.

13. An objective lens drive apparatus according to claim 20 12, wherein the magnet is magnetized in four polarities.

14. An objective lens drive apparatus according to claim 12, wherein the magnet is magnetized in three polarities.

25 15. An objective lens drive apparatus according to claim

12, wherein the number of the focus coils is two, the number of the tracking coils is two, and the number of the tilt coils is two, while said magnet includes two magnet sections respectively disposed in two upper and lower stages in a focus 5 direction and each magnet section magnetized in two polarities in a tracking direction, whereby said the has four poles magnetized.

16. An objective lens drive apparatus according to claim
10 12,

wherein the number of the focus coils is four, the number of the tracking coils is two, and the number of the tilt coils is four,

15 wherein one pole of said magnet has an I-shaped front surface, and two other poles each having a quadrilateral-shaped front surface are inserted into the other space of said one pole, whereby said magnet has a quadrilateral-shaped front surface as a whole and has three poles magnetized.

20 17. An objective lens drive apparatus according to claim
12,

wherein the number of said focus coils is two, the number of said tracking coils is four, and the number of said tilt coils is four,

25 wherein one pole of said magnet has an H-shaped front

surface, and two other poles each having a quadrilateral-shaped front surface are inserted into the other space of said one pole, whereby said magnet has a quadrilateral-shaped front surface as a whole and has three poles magnetized.

5

18. An objective lens drive apparatus according to claim 12,

wherein the number of said focus coils is two, the number of said tracking coils is two, and the number of said tilt 10 coils is four,

wherein one pole of said magnet has a T-shaped front surface, and two other poles each having a quadrilateral-shaped front surface are inserted into the other space of said one pole, whereby said magnet has a quadrilateral-shaped front surface

15 as a whole and has three poles magnetized.

19. An objective lens drive apparatus according to claim 8, wherein the magnetic circuit includes a plurality of the magnet, and the coil unit is disposed within the magnetic gap.

20

20. An objective lens drive apparatus according to claim 8, wherein the coil unit includes a plurality of printed circuit boards, and the focus coil, the tracking coil and the tilt coil are separately mounted on the printed circuit boards.

25

21. An objective lens drive apparatus according to claim
8, wherein the coil unit includes a plurality of first printed
circuit boards and second printed boards, and the focus coil
and the tracking coil are mounted on the first printed circuit
5 board and the tilt coil is mounted on the second printed board.

22. An objective lens drive apparatus according to claim
8, wherein the coil unit includes a plurality of first printed
circuit boards and second printed boards, and the focus coil
10 and the tilt coil are mounted on the first printed circuit
board and the tracking coil is mounted on the second printed
board.

23. An objective lens drive apparatus according to claim
15 8, wherein the coil unit is fixed to the two side surfaces
of a lens holder extending in parallel with a tracking direction.

24. An objective lens drive apparatus used in an optical
pickup for detecting the inclination of an optical disk to
20 adjust the inclination of an objective lens in accordance with
an inclination signal of the optical disk, comprising:

 a magnetic circuit including a magnet magnetized in at
 least three polarities; and
 a coil unit including a focus coil, a tracking coil and
25 a tilt coil,

wherein the focus coil, the tracking coil and the tilt coil are disposed within a magnetic gap of the magnetic circuit,

wherein a focus servo is executed by supplying currents respectively to a plurality of the focus coils due to the sum 5 of drive forces generated in the plurality of focus coils,

wherein the inclination adjustment of the objective lens is executed by generating moment around the center of gravity of a movable part due to the difference between the drive forces.

10 25. An objective lens drive apparatus according to claim 24, wherein the magnet is magnetized in four polarities.

26. An objective lens drive apparatus according to claim 24, wherein the magnet is magnetized in three polarities.

15 27. An objective lens drive apparatus according to claim 24,

wherein the number of the focus coils is two, and the number of the tracking coils is two,

20 wherein said magnet includes two magnet sections respectively disposed in two upper and lower stages in a focus direction and each magnet section magnetized in two polarities in a tracking direction, whereby said the has four poles magnetized.

25

28. An objective lens drive apparatus according to claim
24,

wherein the number of the focus coils is four and the
number of the tracking coils is two,

5 wherein one pole of said magnet has an I-shaped front
surface, and two other poles each having a quadrilateral-shaped
front surface are inserted into the space of said one pole,
whereby said magnet has a quadrilateral-shaped front surface
as a whole and has three poles magnetized.

10

29. An objective lens drive apparatus according to claim
24,

wherein the number of said focus coils is two and the
number of said tracking coils is two,

15 wherein one pole of said magnet has a T-shaped front surface,
and two other poles each having a quadrilateral-shaped front
surface are inserted into the space of said one pole, whereby
said magnet has a quadrilateral-shaped front surface as a
whole and has three poles magnetized.

20

30. An objective lens drive apparatus according to claim
24, wherein the magnetic circuit includes a plurality of the
magnet, and the coil unit is disposed within the magnetic gap
formed by the magnets.

25

31. An objective lens drive apparatus according to claim 24, wherein the coil unit includes a plurality of printed circuit boards, and the focus coil and the tracking coil are separately mounted on the printed circuit boards.

5

32. An objective lens drive apparatus according to claim 24, wherein the coil unit includes a plurality of a printed circuit boards, and the focus coil and the tracking coil are mounted on the printed circuit board.

10

33. An objective lens drive apparatus used in an optical pickup for detecting the inclination of an optical disk to adjust the inclination of an objective lens in accordance with an inclination signal of the optical disk, comprising:

15 a magnetic circuit including a magnet magnetized in at least three polarities; and

a coil unit including a focus coil, a tracking coil and a tilt coil,

20 wherein the focus coil, the tracking coil and the tilt coil are disposed within a magnetic gap of the magnetic circuit,

wherein a tracking servo is executed by supplying currents respectively to a plurality of the tracking coils due to the sum of drive forces generated in the plurality of focus coils,

25 wherein the inclination adjustment of the objective lens is executed by generating moment around the center of gravity

of a movable part due to the difference between the drive forces.

34. An objective lens drive apparatus according to claim 33, wherein the magnet is magnetized in four polarities.

5

35. An objective lens drive apparatus according to claim 33, wherein the magnet is magnetized in three polarities.

36. An objective lens drive apparatus according to claim 10 33,

wherein the number of the focus coils is two and the number of the tracking coils is two

15 wherein the magnet includes two magnet sections respectively disposed in two upper and lower stages in a focus direction and each magnet section magnetized in two polarities in a tracking direction, whereby said the has four poles magnetized.

37. An objective lens drive apparatus according to claim 20 33,

wherein the number of said focus coils is two and the number of said tracking coils is four,

25 wherein one pole of said magnet has an H-shaped front surface, and two other poles each having a quadrilateral-shaped front surface are inserted into the space of said one pole,

whereby said magnet has a quadrilateral-shaped front surface as a whole and has three poles magnetized.

38. An objective lens drive apparatus according to claim 5 33, wherein the magnetic circuit includes a plurality of the magnet, and the coil unit is disposed within the magnetic gap formed by the magnet gaps.

39. An objective lens drive apparatus according to claim 10 33, wherein the coil unit includes a plurality of printed circuit boards, and the focus coil and the tracking coil are separately mounted on the printed circuit boards.

40. An objective lens drive apparatus according to claim 15 33, wherein the coil unit includes a plurality of a printed circuit board, and the focus coil and the tracking coil are mounted on the printed circuit board.

41. An objective lens drive apparatus used in an optical 20 pickup for detecting the inclination of an optical disk to adjust the inclination of an objective lens in accordance with an inclination signal of the optical disk, comprising:

two magnetic circuits respectively including a magnet magnetized in at least three polarities; and

25 a coil unit including a focus coil, a tracking coil and

a tilt coil,

wherein the focus coil, the tracking coil and the tilt coil are disposed within a magnetic gap of the magnetic circuit,

wherein a focus servo is executed by supplying currents 5 respectively to a plurality of the focus coils due to the sum of drive forces generated in the plurality of focus coils,

wherein the inclination adjustment of the objective lens is executed by generating moment around the center of gravity of a movable part due to the difference between the drive forces.

10

42. An objective lens drive apparatus according to claim 41, wherein the magnet is magnetized in four polarities.

15 43. An objective lens drive apparatus according to claim 41, wherein the magnet is magnetized in three polarities.

44. An objective lens drive apparatus according to claim 41,

20 wherein the number of the focus coils is two and the number of the tracking coils is two,

wherein the magnet includes two magnet sections 25 respectively disposed in two upper and lower stages in a focus direction and each magnet section magnetized in two polarities in a tracking direction, whereby said the has four poles magnetized.

45. An objective lens drive apparatus according to claim
41,

5 wherein the number of the focus coils is four and the
number of the tracking coils is two,

wherein one pole of said magnet has an I-shaped front
surface, and two other poles each having a quadrilateral-shaped
front surface are inserted into the space of said one pole,
whereby said magnet has a quadrilateral-shaped front surface
10 as a whole and has three poles magnetized.

46. An objective lens drive apparatus according to claim
41,

15 wherein the number of said focus coils is two and the
number of said tracking coils is two,

wherein one pole of said magnet has a T-shaped front surface,
and two other poles each having a quadrilateral-shaped front
surface are inserted into the space of said one pole, whereby
said magnet has a quadrilateral-shaped front surface as a
20 whole and has three poles magnetized.

47. An objective lens drive apparatus according to claim
41, wherein the magnetic circuit includes a plurality of the
magnet, and the coil unit is disposed within the magnetic gap
25 formed by the magnets.

48. An objective lens drive apparatus according to claim 41, wherein the coil unit includes a plurality of printed circuit boards, and the focus coil and the tracking coil are separately 5 mounted on the printed circuit boards.

49. An objective lens drive apparatus according to claim 41, wherein the coil unit includes a plurality of a printed circuit boards, and the focus coil and the tracking coil are 10 mounted on the printed circuit board.

50. An objective lens drive apparatus used in an optical pickup for detecting the inclination of an optical disk to adjust the inclination of an objective lens in accordance with 15 an inclination signal of the optical disk, comprising:

two magnetic circuits respectively including a magnet magnetized in at least three polarities; and

a coil unit including a focus coil, a tracking coil and a tilt coil,

20 wherein the focus coil, the tracking coil and the tilt coil are disposed within a magnetic gap of the magnetic circuit,

wherein a tracking servo is executed by supplying currents respectively to a plurality of the tracking coils due to the sum of drive forces generated in the plurality of focus coils,

25 wherein the inclination adjustment of the objective lens

is executed by generating moment around the center of gravity of a movable part due to the difference between the drive forces.

51. An objective lens drive apparatus according to claim
5 50, wherein the magnet is magnetized in four polarities.

52. An objective lens drive apparatus according to claim
50, wherein the magnet is magnetized in three polarities.

10 53. An objective lens drive apparatus according to claim
50, wherein the number of the focus coils is two and the number
of the tracking coils is two,
wherein the magnet includes two magnet sections
respectively disposed in two upper and lower stages in a focus
15 direction and each magnet section magnetized in two polarities
in a tracking direction, whereby said the has four poles
magnetized.

54. An objective lens drive apparatus according to claim
20 50,
wherein the number of said focus coils is two and the
number of said tracking coils is four,

wherein one pole of said magnet has an H-shaped front
surface, and two other poles each having a quadrilateral-shaped
25 front surface are inserted into the space of said one pole,

10020933-121901
whereby said magnet has a quadrilateral-shaped front surface as a whole and has three poles magnetized.

55. An objective lens drive apparatus according to claim 50, wherein the magnetic circuit includes a plurality of the 5 magnet, and the coil unit is disposed within the magnetic gap formed by the magnet gaps.

56. An objective lens drive apparatus according to claim 50, wherein the coil unit includes a plurality of printed circuit 10 boards, and the focus coil and the tracking coil are separately mounted on the printed circuit boards.

57. An objective lens drive apparatus according to claim 50, wherein the coil unit includes a plurality of a printed 15 circuit board, and the focus coil and the tracking coil are mounted on the printed circuit board.